Correlation Between Serum Lipids and Primary Open Angle Glaucoma: A Clinical Study

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Abstract

Background: Glaucoma is a leading cause of blindness worldwide. Intraocular pressure is the primary risk factor. But in spite of control of intraocular pressure, some cases progress which strengthens the view that there must be other independent risk factors in pathogenesis of glaucoma. Serums lipids have been found to be associated with glaucoma in few studies. We carried out the present study to study the relation between serum lipids and Primary Open Angle Glaucoma (POAG).

Materials and Methods: This study was conducted on 40 patients with POAG and 40 individuals without glaucoma (controls). Ophthalmic examination was performed in all the patients and fasting lipid profile including total cholesterol, triglycerides, Low Density Lipoproteins (LDL) and High Density Lipoproteins (HDL) were measured and analysed between the cases and controls.

Results: Level of total cholesterol, total triglycerides, and LDL were significantly higher in cases than in controls with p value < 0.05. Level of HDL was lower in cases than in controls but it was not statistically significant.

Conclusion: Dyslipidemia is an independent risk factor for POAG. High serum cholesterol, high serum triglycerides and high serum LDL correlate significantly with POAG.

Introduction

Primary open-angle glaucoma (POAG) is a chronic and progressive eye disease that is the second leading cause of blindness in India.[1] In India, there are approximately 11[2] million persons aged 40 years and older with glaucoma. Primary open angle glaucoma (POAG) is estimated to affect 6.48 million persons.[1] It is usually asymptomatic till advanced stages of the disease. Regarding the importance of the disease; identifying its risk factors is necessary. Different factors have been stated to have their own role in the incidence of the disease.

High intraocular pressure (IOP) is the primary risk factor. Raised IOP leads to the process of optic nerve damage by either direct mechanical damage to the retinal nerve fibre layer or ischaemic damage due to compression of blood vessels supplying the optic nerve head.[2] However, it is understood that there must be other risk factors also, which by modulating IOP or by other different mechanisms may lead to causation and progression of glaucoma.

POAG is known to be associated with diabetes mellitus (DM) type 2 and hypertension. Diabetes and hypertension are linked to high lipid levels (dyslipidemia and insulin resistance being interrelated) and high lipid levels cause atherosclerotic changes leading to Hypertension. Thus there is possibility that glaucoma is indirectly related to serum lipid levels.[3]

Lipid peroxidation leading to oxidative stress may directly damage trabecular meshwork and endothelium of blood vessels supplying optic nerve head or atherosclerotic changes due to high cholesterol level may affect ocular perfusion.[4] This study attempts to establish a relation between serum lipids and its components with primary open angle glaucoma.

Material and Methods

This case-control study was conducted in the department of Ophthalmology of a tertiary care hospital in Central India from February 2015 to August 2016. Forty patients of POAG and forty healthy volunteers were included in the study. Written informed consent was taken from all the subjects. Individuals over 18 years of age with primary open angle glaucoma having no other ocular disease were included in the study. History of ocular trauma, other eye disease (except refractive error) and patients with systemic diseases with ocular involvement like diabetes and hypertensionwere excluded. Persons taking lipid lowering drugs like statins were also excluded.

Demographic data including age, gender, address were noted. Ophthalmic examination was performed like visual acuity using Snellen's chart, Anterior segment examination, slit lamp examination, pupillary reactions, Van-Herick's grading, intraocular pressure measurement using Goldmannapplanation tonometer. Gonioscopywas done to evaluate the angle structures. Fundus examination and visual field defects were performed. Primary open angle glaucoma was diagnosed on the basis of raised IOP, optic nerve head changes detected by direct ophthalmoscopy and visual field defects.

Twelve hour fasting blood samples were collected for measuring serum lipids and assessed using enzymatic method (autoanalyzer). The lipid profile included total cholesterol, triglycerides (TGL), Low Density Lipoproteins (LDL) and High Density Lipoproteins (HDL).Reference values for lipids were taken from National Cholesterol Education Program: Adult Treatment Panel III (NCEP: ATP III) guidelines[5], according to which Hypercholesterolemia is defined as total cholesterol > 200 mg/dl, Hypertriglyceridemia, when

triglycerides > 150 mg/dl, LDL > 130 mg/dl were considered high andHDL < 40 mg/dl were considered low.

Mean, Standard deviation and standard error of means were calculated. Statistical analysis was performed using unpaired t-test using SPSS software. P value < 0.05 was considered significant.

Results

Demographic parameters of the study population are shown in Table 1.

Table 1: Demographic parameters of study population

Parameter	Cases (n = 40)	Controls (n = 40)
Mean age (years)	56 years	54 years
Gender (Male: Female)	13:7	23:17
Obesity (BMI* ≥ 25)	6/40 (15%)	2/40 (5%)
Locality	30/40 urban (75%)	22/40 urban (55%)

* BMI- Body Mass Index

The age of patients ranged from 40 to 80 years with a mean of 56 years (cases) and 54 years (control). The maximum number of cases and controls were between the ages of 50-60 years of age group. The male to female ratio was 13:7 in cases and 23:17 in controls. Thirty out of 40 (75%) cases and 22 out of 40 (55%) controls were from urban background whereas 10 out of 40 (25%) of the POAG cases and 18 out of 40 (45%) controls were from rural areas. Nineteen out of 40 (47.5%) cases were overweight or obese, 6 obese and 13 overweight. Amongst controls 12 had BMI in higher range, 2 were obese and 10 were overweight (30%).

High Cholesterol (>200mg/dl) was seen in 20 cases, whereas in controls, 7 individuals have high cholesterol. High Triglycerides (>150mg/dl) was seen in 18 cases whereas 6 controls have high triglycerides. LDL was high (> 130 mg/dl) in 24 cases and 7 controls. HDL was low (< 40mg/dl) in 27 cases and 13 controls (Table 2).

Table 2: Dyslipidemia in cases and controls

Lipid parameters	Cases (n = 40)	Controls (n = 40)
High cholesterol (> 200 mg/dl)	20/40 (50%)	7/40 (17.5%)
High triglyceride (> 150 mg/dl)	18/40 (45%)	6/40 (15%)
High LDL (> 130 mg/dl)	24/40 (60%)	7/40 (17.5%)
Low HDL (< 40 mg/dl)	27/40 (67.5%)	13/40 (32.5%)

In cases, mean total cholesterol was 215.95 +/- 6.44 mg/dl; mean triglycerides was 153.05 +/- 7.87 mg/dl; mean LDL level was 142.7 +/- 6.24 mg/dl and mean HDL was 39.68 +/- 1.55 mg/dl. In controls, mean total cholesterol was 168.35 +/- 5.16 mg/dl; mean triglycerides was 108.60 +/- 6.32 mg/dl; mean LDL level was 102.2 +/- 4.39 mg/dl and mean HDL was 40.83 +/- 1.63 mg/dl (Table 3).

Table 3: Serum lipid values in cases and controls

Parameters	Cases (n = 40)	Controls (n = 40)
Mean cholesterol (mg/dl)	215.95 +/- 6.44	168.35 +/- 5.16
Mean triglyceride (mg/dl)	153.05 +/- 7.87	108.60 +/- 6.32
Mean LDL (mg/dl)	142.7 +/- 6.24	102.2 +/- 4.39
Mean HDL (mg/dl)	39.68 +/- 1.55	40.83 +/- 1.63

Level of total cholesterol, total triglycerides, and LDL were significantly higher in cases than in controls with p value < 0.05 taking confidence interval 95%. Level of HDL was lower in cases than in controls but it was not statistically significant.

Discussion

The results obtained showed that there is a significant relationship between high cholesterol, LDL, and triglyceride and low HDL to POAG. HDL was found to be lower in cases than controls but this was not statistically significant.

Kovačević et al[6] concluded in their study that patients with higher values of total cholesterol, particularly atherogenic LDL fraction, may have certain influence in glaucoma. Serum lipid values were similar in both groups for triglycerides, HDL and LDL lipoproteins but cholesterol values were significantly higher in the POAG group. Egorowetal[7] showed that lipid biochemical analysis in patients with glaucoma may have atherogenic hyperlipidaemia with lower antioxidative activity. The statins in usage longer than 23 months may significantly reduce the risk of glaucoma.[8] Therefore, the statins usage in hyperlipidaemia therapy could not change intraocular pressure values in patients with glaucoma but could reduce the risk of glaucoma.

In a case control study conducted by Davari et al[9], there was a positive association between POAG and dyslipidemia (OR=7.14 [95% CI: 2.3-22.2] for Hypercholerolemia and OR=16.9 [95% CI: 2.1-14.8] for hypertriglyceridemia. Conclusion was drawn that hyperlipidemia can be a risk factor for POAG.

In a similar study in 2009, by Pavljasević and Asćerić[10] in Bosnia and Herzegovina, the researchers tested 50 patients with open-angle glaucoma and 50 healthy individuals with respect to their serum lipids. The cholesterol mean value in the test group was 6.14 mol/dm whereas in the control group it was 5.96 mol/dm. The triglyceride mean value in the test group was 2.38 mol/dm and in the control group it was 2.04 mol/dm. High density cholesterol was average in the test group with 1.45 mol/dm and in the control group 1.40 mol/m. Low density cholesterol in the test group was 3,98 mol/m and in the control group 4.08 mol/m. This means that blood cholesterol levels for patients in the test group were higher compared to those of the control group and could suggest that hypercholesterolemia could be one of predictable factor in POAG diagnosis.

In the Beijing eye study[11], about 3251 individuals (age>45 years) had their complete ophthalmic examination. Blood serum lipids were also measured. After adjustment of various factors (such as age, sex, residence, income level, BMI, cigarette smoking, diastolic blood pressure, and blood sugar) the effect of dyslipidemia on the incidence of ophthalmic diseases was studied. Results showed in dyslipidemic patients, IOP was significantly increased.

In a study done by Chisholm and Stead[12] in1988 on 183 patients (92 women and 91 men) with glaucoma, with the aim of surveying serum lipid levels, it was found that only triglycerides in female adults was significantly high.

In a study by Stewart et al[13] in 1996, a comparison was made between total cholesterol and HDL of 25 glaucoma patients

and 25 healthy individuals, which showed that there is no relationship between HDL and total cholesterol to IOP or POAG.

Maybe, the relationship between lipids and glaucoma is due to the association of this disorder with other cardiac risk factors such as diabetes and hypertension. In a study conducted in Michigan university people aged >40 years who had one or more ophthalmic visit were included in a cohort study (2001-2007). The aim of this study was to assess the elements of metabolic syndrome and glaucoma. The results showed that diabetes and hypertension proper or associated with each other have a role in occurrence of glaucoma but dyslipidemia alone even lowered the risk of glaucoma by about 5%. However, in cases that dyslipidemia is associated with diabetes or hypertension the risk increases.[14] These results points to a combined effect of dyslipidemia with hypertension or diabetes in pathogenesis of glaucoma. In our study we find that dyslipidemia is an independent risk factor for glaucoma after removing these confounding factors.

These studies will help us in understanding the mechanisms by which dyslipidemia leads to development of POAG. Various studies showing increased levels of lipid peroxides in the aqueous humor, trabecular meshwork and Schlemm's canal in POAG cases compared with control eyes suggest that lipid peroxidation by increasing oxidative stress is responsible for destruction of the trabecular meshwork and Schlemm's canal.[15-17]

Conclusion

We conclude that dyslipidemia is an independent risk factor for POAG. High serum cholesterol, high serum triglycerides and high serum LDL correlate significantly with POAG. Thus, treatment of dyslipidemia can provide a potential preventing strategy for primary open angle glaucoma (POAG).

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